

PATENT ABSTRACTS OF JAPAN

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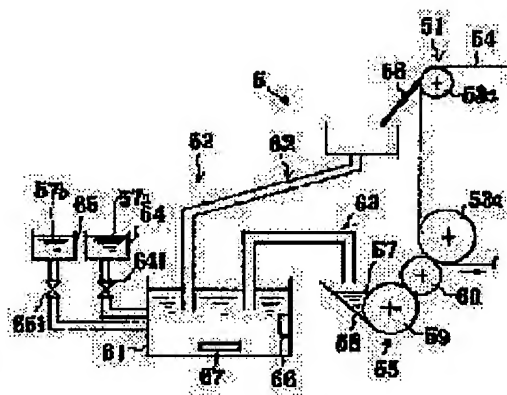
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(54) LIQUID DEVELOPING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To form an image with good quality and also to effectively utilize liquid developer by adequately keeping the concentration of the liquid developer used in developing to fixed concentration.

SOLUTION: The viscosity U of the liquid developer inside a developer storage tank 61 to which the liquid developer recovered from a developing belt 54 is added is detected; the liquid developer with high concentration and the liquid developer with low concentration are supplied when the viscosity U of the liquid developer exceeds an allowable viscosity range, so that the viscosity U of the liquid developer inside the tank 61 becomes initial viscosity U_0 the electrostatic latent image formed on the photoreceptor 1 is visualized by the liquid developer always having the viscosity in the allowable viscosity range, and the image with the good quality can be stably formed.



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CLAIMS

[Claim(s)]

[Claim 1] The liquid-development agent of high viscosity which distributed the development particle in the developer solvent which consists of an insulating liquid at high concentration is applied to a developer support by the thin layer. It is liquid-development equipment which visualizes the electrostatic latent image formed in the image support by the development particle contained in the high-concentration liquid-development agent to which it was applied by the developer support by the thin layer. Liquid-development equipment characterized by having the developer feeder which supplies the liquid-development agent adjusted to the fixed range which set viscosity to a developer application means to apply a liquid-development agent to a developer support, and to form a liquid-development agent thin layer, beforehand.

[Claim 2] Liquid-development equipment according to claim 1 which collects the liquid-development agents which remain to the above-mentioned developer feeder at the developer support after development field passage.

[Claim 3] Liquid-development equipment according to claim 1 or 2 with which the viscosity of the liquid-development agent in the above-mentioned developer feeder is detected, the ratio of a development particle supplies a large liquid-development agent with high viscosity to a developer feeder when the viscosity of a liquid-development agent becomes below the lower limit defined beforehand, and the ratio of a development particle supplies the low liquid-development agent of viscosity to a developer feeder small when it becomes more than the upper limit which the viscosity of a liquid-development agent defined beforehand.

[Claim 4] Liquid-development equipment according to claim 1 or 2 which detects the viscosity of the liquid-development agent in the above-mentioned developer feeder, supplies a development particle to a developer feeder when the viscosity of a liquid-development agent becomes below the lower limit defined beforehand, and supplies the developer solvent which consists of an insulating liquid when it becomes more than the upper limit which the viscosity of a liquid-development agent defined beforehand to a developer feeder.

[Claim 5] the time of setting initial viscosity of the liquid-development agent in the above-mentioned developer feeder to U_o , and setting to U_c viscosity of the developer solvent which consists of an insulating liquid — the viscosity U of the liquid-development agent in a developer feeder — $\{U_o - (U_o - U_c)/2\} < U < \{U_o + (U_o - U_c)/2\}$

Liquid-development equipment according to claim 3 or 4 adjusted so that it may become ****.*.

[Claim 6] Liquid-development equipment according to claim 5 which agitates the liquid-development agent in the above-mentioned developer feeder, and is made into uniform viscosity.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] This invention relates to homogenization of the liquid-development equipment which develops the electrostatic latent image formed by the electrophotography method etc. using hyperviscosity and a high-concentration liquid-development agent, especially development.

[0002]

[Description of the Prior Art] The image formation equipment which visualizes an electrostatic latent image using hyperviscosity and a high-concentration liquid-development agent is indicated by JP,7-239614,A, JP,8-123205,A, etc. This image formation equipment applies the pulley wet liquid which has a mold-release characteristic with a pulley wet liquid application means on a photo conductor front face, and has an inactive dielectric and light-transmission nature chemically by uniform thickness, after being uniformly charged with an electrification means in a photo conductor front face. Then, according to image data, a photo conductor front face is exposed by the write-in means, an electrostatic latent image is formed, and it visualizes with liquid-development equipment.

[0003] Liquid-development equipment is what visualizes an electrostatic latent image by the liquid-development agent of high viscosity by which the toner which is a development particle was distributed by high concentration in the developer solvent which consists of insulating liquids, such as for example, dimethylpolysiloxane oil. When the liquid-development agent thin layer which applied the liquid-development agent to the development belt or the developing roller by uniform thickness by the developer application means, and was applied to the development belt or the developing roller approaches a photo conductor and passes along a development field, the toner of a liquid-development agent thin layer transfers to the picture field of a photo conductor, and forms a toner image. The toner image which imprinted the toner image formed in the photo conductor to the transfer paper with the imprint means, and was imprinted to the transfer paper is established, and a picture is formed. The toner and pulley wet liquid which remained to the photo conductor after an imprint process end are removed with a cleaning means, remove the charge which remains in the photo conductor by the electric discharge means, and end an image formation process. Moreover, it mixes with the liquid-development agent which remained without the pulley wet liquid applied to the photo conductor adhering to the development belt passing through the development field, or a developing roller, and being used for development. Collect the liquid-development agents and pulley wet liquid adhering to the development belt passing through this development field, or the developing roller for a developer application means, and reuse, or collect on a waste fluid recovery tank and it discards, or the liquid-development agent and pulley wet liquid which were collected are separated, and the separated liquid-development agent is reused.

[0004] If the liquid-development agent and pulley wet liquid adhering to the development belt which passed along the development field as mentioned above, or the developing roller are collected and discarded, a liquid-development agent will become useless and operation cost will become high. Moreover, when separating and reusing a liquid-development agent and pulley wet

liquid, while it may be difficult practically to equip a developer with a separation mechanism, depending on the property of pulley wet liquid, it may be inseparable with a liquid-development agent. Then, it is usually collecting and reusing for the developer application means.

[0005]

[Problem(s) to be Solved by the Invention] Although the toner of a liquid-development agent is consumed according to the existence of a picture, or its ratio when visualizing an electrostatic latent image using a liquid-development agent, the coating weight of a solvent is not so much dependent on the existence of a picture. Usually, although the liquid-development agent which the toner distributed is used into the solvent by the fixed ratio, when an electrostatic latent image with the high ratio of picture area is repeated and developed, for example, compared with consumption of a solvent, consumption of a toner becomes remarkably large, low liquid-development agents are collected for the ratio of a toner by the developer application means to a solvent, and the concentration which is the ratio of the solvent of the liquid-development agent within a developer application means and a toner falls. The concentration of the picture formed when the concentration of a liquid-development agent fell will also fall.

[0006] Conversely, when the development of the low static latent image of the rate of picture surface ratio is repeated, liquid-development agents with the high ratio of a toner will be collected by the developer application means to a solvent, and the concentration which is the ratio of the solvent of the liquid-development agent within a developer application means and a toner will become high. Nonuniformity etc. will arise to the picture concentration developed while the viscosity of a liquid-development agent becomes high, and the coating weight when applying a liquid-development agent to a development belt or a developing roller changes and being hard coming to form the liquid-development agent thin layer of uniform thickness, when the concentration of the liquid-development agent within a developer application means became high, and quality of image will deteriorate.

[0007] It is made in order that this invention may improve this demerit, and while maintaining at suitable fixed concentration the concentration of the liquid-development agent used for development and forming a good picture, it aims at obtaining the liquid-development equipment which can use a liquid-development agent effectively.

[0008]

[Means for Solving the Problem] The liquid-development equipment concerning this invention applies to a developer support the liquid-development agent of high viscosity which distributed the development particle in the developer solvent which consists of an insulating liquid at high concentration by the thin layer. It is liquid-development equipment which visualizes the electrostatic latent image formed in the image support by the development particle contained in the high-concentration liquid-development agent to which it was applied by the developer support by the thin layer. It is characterized by having the developer feeder which supplies the liquid-development agent adjusted to the fixed range which set viscosity to a developer application means to apply a liquid-development agent to a developer support, and to form a liquid-development agent thin layer, beforehand.

[0009] It is good for the above-mentioned developer feeder to collect the liquid-development agents which remain to the developer support after development field passage.

[0010] Moreover, the viscosity of the liquid-development agent in the above-mentioned developer feeder is detected, when the viscosity of a liquid-development agent becomes below the lower limit defined beforehand, the ratio of a development particle supplies a large liquid-development agent with high viscosity to a developer feeder, and when it becomes more than the upper limit which the viscosity of a liquid-development agent defined beforehand, the ratio of a development particle supplies the low liquid-development agent of viscosity to a developer feeder small.

[0011] When the viscosity of the liquid-development agent in the above-mentioned developer feeder becomes below the lower limit defined beforehand, a development particle is supplied to a developer feeder, and when it becomes more than the upper limit which the viscosity of a liquid-development agent defined beforehand, you may supply the developer solvent which consists of an insulating liquid to a developer feeder.

[0012] Moreover, when initial viscosity of the liquid-development agent in a developer feeder is set to U_0 and viscosity of the developer solvent which consists of an insulating liquid is set to U_c , it is desirable to adjust the viscosity U of the liquid-development agent in a developer feeder so that it may become the range of $\{U_0 - (U_0 - U_c)/2\} < U < \{U_0 + (U_0 - U_c)/2\}$.

[0013] Furthermore, it is good to agitate the liquid-development agent in a developer feeder, and to make it uniform viscosity.

[0014]

[Embodiments of the Invention] The liquid-development equipment of this invention has a developer main part and a developer supply unit. A developer main part has the development belt which moves at the same surface migration speed as the surface migration speed of a photo conductor, a developer application means, and a developer cleaning means. A developer supply unit has a developer storage tank, a developer stripping section, a developer feed zone, a high concentration developer feed zone, and a low concentration developer feed zone. In a developer storage tank, it has a viscometer and a churning means, and the liquid-development agent supplied to a developer application means is stored. A developer feed zone supplies the liquid-development agent stored in the developer storage tank to a developer application means. A high concentration developer feed zone stores a high concentration liquid-development agent with high viscosity with the large ratio of a toner, and supplies the stored high concentration liquid-development agent to a developer storage tank. There are few ratios of a toner and a low concentration developer feed zone supplies the low concentration liquid-development agent which viscosity stored the low low concentration liquid-development agent, and has stored to a developer storage tank.

[0015] When developing and visualizing the electrostatic latent image formed in the photo conductor with this liquid-development equipment, the liquid-development agent thin layer of the uniform thickness of a liquid-development agent is formed in a rotating development belt with a developer application means. The electrostatic latent image of a photo conductor is visualized with the toner contained in the liquid-development agent thin layer of the uniform thickness formed in this development belt. The liquid-development agent which remained in the development belt after this development process is removed by the developer cleaning means, and the removed liquid-development agents are collected by the developer storage tank by the developer stripping section of a developer supply unit.

[0016] The developer solvent in the liquid-development agent collected by this developer storage tank may be changed according to the area of the picture which a toner develops to constant-rate consumption always being carried out at a development process, and it may be changing, the ratio, i.e., the concentration, of a toner to the developer solvent of a liquid-development agent collected by the developer storage tank. Then, the viscosity of the liquid-development agent in the developer storage tank with which the liquid-development agent collected from the photo conductor belt with the viscometer in a developer storage tank is added is detected. When the viscosity of the liquid-development agent in a developer storage tank becomes lower than the lower limit of the permission viscosity range It mixes with the high-concentration liquid-development agent which supplied the high-concentration liquid-development agent to the developer storage tank from the high concentration developer feed zone, and was supplied by agitating the liquid-development agent in a developer storage tank with the churning means, and is made uniform viscosity, and the viscosity of the liquid-development agent in a developer storage tank is adjusted to initial viscosity. Moreover, if the viscosity of the liquid-development agent in a developer storage tank becomes higher than the upper limit of the permission viscosity range, a low-concentration liquid-development agent will be supplied to a developer storage tank from a low concentration developer feed zone, and the viscosity of the liquid-development agent in a developer storage tank will be adjusted to initial viscosity.

[0017] Thus, the viscosity U of the liquid-development agent in the developer storage tank with which the liquid-development agent collected from the development belt is added is detected. Since a high-concentration liquid-development agent or a low-concentration high-concentration liquid-development agent is supplied and viscosity U of the liquid-development agent in a

developer storage tank is made into initial viscosity U_0 when the viscosity U of a liquid-development agent exceeds the permission viscosity range. The electrostatic latent image formed in the photo conductor by the liquid-development agent which always has the viscosity of permission viscosity within the limits can be visualized, it is stabilized and a good picture can be formed.

[0018] Moreover, since it agitates with a churning means and viscosity of the liquid-development agent in a developer storage tank is made into uniform viscosity while supplying a high-concentration liquid-development agent or a low-concentration high-concentration liquid-development agent, when the viscosity U of a liquid-development agent exceeds the permission viscosity range, it can prevent concentration nonuniformity etc. arising in the formed picture.

[0019] Furthermore, if threshold value ΔU_0 which defines the permission viscosity range ($U_0 \pm \Delta U_0$) over initial viscosity U_0 sets up with $\Delta U_0 = (U_0 - U_c) / 2$ by setting viscosity of a developer solvent to U_c , it can form an always good picture.

[0020] Moreover, you may supply a toner or a developer solvent instead of a high-concentration liquid-development agent or a low-concentration liquid-development agent.

[0021]

[Example] Drawing 1 is the block diagram of the wet image formation equipment which used the liquid-development equipment of one example of this invention. Wet image formation equipment has the electrification means 2 and the pulley wet liquid application means 3 which have been arranged along with the photo conductor 1 which rotates clockwise, the write-in means 4, liquid-development equipment 5, the imprint means 6, the electric discharge means 7, and the cleaning means 8, as shown in drawing. After a front face is uniformly charged with the electrification means 2, the pulley wet liquid which has a mold-release characteristic with the pulley wet liquid application means 3, and has an inactive dielectric and light-transmission nature chemically is applied to a photo conductor 1 by uniform thickness. The photo conductor 1 with which this front face was uniformly charged and pulley wet liquid was applied is exposed according to image data by the write-in means 4, and an electrostatic latent image is formed. The electrostatic latent image formed in this photo conductor 1 is visualized with liquid-development equipment 5, and the toner image which formed and formed the toner image is imprinted to a transfer paper 9 with the imprint means 6. Discharging the charge which remains in the photo conductor 1 which imprinted the toner image to the transfer paper 9 with the electric discharge means 7, the toner and pulley wet liquid which remained are removed with the cleaning means 7, and go into the following image formation process.

[0022] In the developer solvent which consists of insulating liquids, such as for example, dimethylpolysiloxane oil, liquid-development equipment 5 visualizes an electrostatic latent image by the liquid-development agent of high viscosity by which the toner which is a development particle was distributed by high concentration, and has the developer main part 51 and the developer supply unit 52. The developer main part 51 has the development belt 54 which is wound around two or more rotation rollers 53a-53e, and moves counterclockwise at the same surface migration speed as the surface migration speed of a photo conductor 1, the developer application means 55, and the developer cleaning means 56. As for the development belt 54, the potential between the minimum value of the latent-image potential on a photo conductor 1 and maximum is impressed by the bias impression means (un-illustrating). The developer application means 55 has the developer stores dept. 58, the feed roller 59, and the application roller 60 with which the liquid-development agent 57 of the hyperviscosity which distributed the toner was stored into the developer solvent, and forms the liquid-development agent thin layer of uniform thickness in development belt 54 front face. The developer cleaning means 56 collects the liquid-development liquid which remains to the development belt 54 which passed through the development field.

[0023] The developer supply unit 52 has the developer storage tank 61, the developer stripping section 62, the developer feed zone 63, the high concentration developer feed zone 64, and the low concentration developer feed zone 65, as shown in drawing 2. In the developer storage tank 61, it has a viscometer 66 and the churning means 67, and the liquid-development agent supplied to the developer application means 55 is stored. The developer stripping section 62 sends the

liquid-development liquid collected with the developer cleaning means 56 to the developer storage tank 61. The developer feed zone 63 supplies the liquid-development agent stored in the developer storage tank 61 to the developer application means 55. In order that the high concentration developer feed zone 64 may form the picture of the optimal picture concentration, the ratio of the toner to a developer solvent is adjusted the optimal, and viscosity supplies high concentration liquid-development agent 57a which has stored and stored high concentration liquid-development agent 57a with high viscosity with the large ratio of a toner from the liquid-development agent of Uo to the developer storage tank 61. There are few ratios of a toner than the liquid-development agent of Uo, and, as for the low concentration developer feed zone 65, viscosity supplies low concentration liquid-development agent 57b which viscosity stored low low concentration liquid-development agent 57b, and has been stored to the developer storage tank 61.

[0024] In the control section of the developer supply unit 52, as shown in drawing 3, it has the criteria viscosity entry section 68, a comparator 69, and the drive control section 70. The criteria viscosity entry section 68 sets up the criteria viscosity range for controlling the liquid-development agent stored in the developer storage tank 61 to proper viscosity, i.e., proper toner content. A comparator 69 compares the viscosity of the liquid-development agent stored in the developer storage tank 61 detected with the viscometer 66 with the criteria viscosity range set up in the criteria viscosity entry section 68, and the viscosity of the liquid-development agent stored in the developer storage tank 61 judges criteria viscosity within the limits or no. The drive control section 70 drives the supply means 641 of the high concentration developer feed zone 64 or the supply means 651 of the low concentration developer feed zone 65, and the churning means 67 by the judgment result of a comparator 69.

[0025] In the liquid-development equipment 5 constituted as mentioned above, in order to form the picture of the optimal picture concentration in the developer storage tank 61 of the developer supply unit 52 at the time of the first stage, the liquid-development agent of the initial viscosity Uo which adjusted the ratio of the toner to a developer solvent the optimal is stored, and this liquid-development agent is supplied to the developer stores dept. 58 of the developer application means 55. When developing and visualizing the electrostatic latent image formed in the photo conductor 1 with this liquid-development equipment 5, the liquid-development agent thin layer of the uniform thickness of the liquid-development agent 57 is formed in the development belt 54 which is rotating counterclockwise with the developer application means 55. The electrostatic latent image of a photo conductor 1 is visualized with the toner contained in the liquid-development agent thin layer of the uniform thickness formed in this development belt 54. When visualizing the electrostatic latent image of this photo conductor 1, a toner adheres only to the picture section of an electrostatic latent image, and the developer solvent which is a carrier adheres to all the fields of a photo conductor 1. The liquid-development agent which remained in the development belt 54 after this development process is removed by the developer cleaning means 56, and the removed liquid-development agents are collected by the developer storage tank 61 by the developer stripping section 62 of the developer supply unit 52.

[0026] The developer solvent in the liquid-development agent collected by this developer storage tank 61 is changed according to the area of the picture which a toner develops to constant-rate consumption always being carried out at a development process. If it may be changing, the ratio, i.e., the concentration, of a toner to the developer solvent of a liquid-development agent collected by the developer storage tank 61, and this collected liquid-development agent is added to the liquid-development agent in the developer storage tank 61. It will change from initial viscosity Uo, the concentration, i.e., the viscosity, of a liquid-development agent in the developer storage tank 61. The ratio of the toner to the viscosity, i.e., the developer solvent, of a liquid-development agent If the picture concentration when visualizing the electrostatic latent image of a photo conductor 1 is influenced directly and the viscosity of the liquid-development agent to supply, the liquid-development agent 55, i.e., the developer application means, in the developer storage tank 61, falls as shown in the property view of the viscosity of drawing 4, and picture concentration The concentration of the picture formed in the photo conductor 1 also falls, and if the viscosity of a liquid-development agent carries out a

fixed limit fall, the quality of a picture will deteriorate. Moreover, if the viscosity of the liquid-development agent in the developer storage tank 61 becomes high, the coating weight when applying a liquid-development agent will change to the development belt 54 with the developer application means 55, it will be hard coming to form the liquid-development agent thin layer of uniform thickness, and nonuniformity etc. will arise to picture concentration.

[0027] Then, the viscosity U of the liquid-development agent in the developer storage tank 61 with which the liquid-development agent collected from the development belt 54 with the viscometer 66 in the developer storage tank 61 is added is detected to fixed always or time timing, and it sends to a comparator 69. A comparator 69 judges whether the viscosity U of the liquid-development agent in the developer storage tank 61 is over the permission viscosity range ($U_o \pm \Delta U_o$) as compared with the permission viscosity range ($U_o \pm \Delta U_o$) over the viscosity U of the sent liquid-development agent, and the initial viscosity U_o beforehand set as the criteria viscosity entry section 68. A comparator 69 sends the signal which shows whether the viscosity U of a liquid-development agent is lower than the lower limit ($U_o - \Delta U_o$) of the permission viscosity range, or higher than ($U_o + \Delta U_o$) in a upper limit to the drive control section 70, when the viscosity U of the liquid-development agent in the developer storage tank 61 is over the permission viscosity range ($U_o \pm \Delta U_o$) as a result of this comparison. If the drive control section 70 receives the signal which shows that the viscosity U of a liquid-development agent is lower than the lower limit ($U_o - \Delta U_o$) of the permission viscosity range, it drives the supply means 641 of the high concentration developer feed zone 64, will supply high-concentration liquid-development agent 57a to the developer storage tank 61, will drive the churning means 67 simultaneously, will mix the liquid-development agent in the developer storage tank 61 with high-concentration liquid-development agent 57a supplied by agitating, and will make it uniform viscosity. When supplying this high-concentration liquid-development agent 57a, a viscometer 66 is detected and sends the viscosity U of the liquid-development agent in the developer storage tank 61 to a comparator 69. If the viscosity U of the liquid-development agent in the developer storage tank 61 turns into initial viscosity U_o , a comparator 69 will send a supply interruption signal to the drive control section 70, and will stop the drive of the supply means 641 of the high concentration developer feed zone 64. Moreover, if the signal which shows that the viscosity U of a liquid-development agent is higher than the upper limit ($U_o + \Delta U_o$) of the permission viscosity range is received, the drive control section 70 will drive the supply means 651 of the low concentration developer feed zone 65, and will supply low-concentration liquid-development agent 57b to the developer storage tank 61. The churning means 67 is driven, the liquid-development agent in the developer storage tank 61 is mixed with low-concentration liquid-development agent 57b supplied by agitating, it is made uniform viscosity, and the viscosity U of the liquid-development agent in the developer storage tank 61 is adjusted to initial viscosity U_o .

[0028] Thus, the viscosity U of the liquid-development agent in the developer storage tank 61 with which the liquid-development agent collected from the photo conductor belt 54 is added is detected. Since high-concentration liquid-development agent 57a or low-concentration liquid-development agent 57b is supplied and viscosity U of the liquid-development agent in the developer storage tank 61 is made into the permission viscosity range ($U_o \pm \Delta U_o$) when the viscosity U of a liquid-development agent exceeds the permission viscosity range ($U_o \pm \Delta U_o$) The electrostatic latent image formed in the photo conductor 1 by the liquid-development agent which always has the viscosity within the permission viscosity range ($U_o \pm \Delta U_o$) can be visualized, it is stabilized and a good picture can be formed. Moreover, since it agitates with the churning means 67 and is made uniform viscosity while supplying high-concentration liquid-development agent 57a or low-concentration liquid-development agent 57b, when the viscosity U of a liquid-development agent exceeds the permission viscosity range ($U_o \pm \Delta U_o$), it can prevent concentration nonuniformity etc. arising in the formed picture.

[0029] Moreover, as it was shown in the property view of the rate of a toner solid content and viscosity of drawing 5, using viscosity of a developer solvent as U_c , when threshold value ΔU_o which defines the permission viscosity range ($U_o \pm \Delta U_o$) over the initial viscosity U_o set as the criteria viscosity entry section 68 set up with $\Delta U_o = (U_o - U_c) / 2$, it was able to

form the always good picture.

[0030] Moreover, although the above-mentioned example explained the case where high-concentration liquid-development agent 57a or low-concentration liquid-development agent 57b was supplied when the viscosity U of the liquid-development agent in the developer storage tank 61 with which the liquid-development agent collected from the photo conductor belt 54 is added exceeded the permission viscosity range ($U_o \pm \Delta U_o$) The viscosity U of a liquid-development agent supplies a toner to the liquid-development agent in the developer storage tank 61, when lower than the lower limit ($U_o - \Delta U_o$) of the permission viscosity range. When higher than the upper limit ($U_o + \Delta U_o$) of the permission viscosity range, you may make it the viscosity U of a liquid-development agent supply the developer solvent of viscosity U_c to the liquid-development agent in the developer storage tank 61.

[0031]

[Effect of the Invention] This invention detects the viscosity of the liquid-development agent in the developer storage tank with which the liquid-development agent collected from the development belt is added, as explained above. Since a high-concentration liquid-development agent or a low-concentration high-concentration liquid-development agent is supplied and viscosity of the liquid-development agent in a developer storage tank is made into initial viscosity when the viscosity of a liquid-development agent exceeds the permission viscosity range The electrostatic latent image formed in the photo conductor by the liquid-development agent which always has the viscosity of permission viscosity within the limits can be visualized, it is stabilized and a good picture can be formed.

[0032] Moreover, since it agitates with a churning means and viscosity of the liquid-development agent in a developer storage tank is made into uniform viscosity while supplying a high-concentration liquid-development agent or a low-concentration high-concentration liquid-development agent, when the viscosity of a liquid-development agent exceeds the permission viscosity range, it can prevent concentration nonuniformity etc. arising in the formed picture.

[0033] Furthermore, threshold value ΔU_o which defines the permission viscosity range ($U_o \pm \Delta U_o$) over initial viscosity U_o can form an always good picture by setting up with $\Delta U_o = (U_o - U_c) / 2$ by setting viscosity of a developer solvent to U_c .

[0034] Moreover, the viscosity of the liquid-development agent used for development can be easily adjusted by supplying a toner or a developer solvent instead of a high-concentration liquid-development agent or a low-concentration liquid-development agent.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the block diagram of the example of this invention.

[Drawing 2] It is the block diagram of liquid-development equipment.

[Drawing 3] It is the block diagram showing the composition of the control section of a developer supply unit.

[Drawing 4] It is the property view of viscosity and picture concentration.

[Drawing 5] It is the property view of the rate of a toner solid content, and viscosity.

[Description of Notations]

1 Photo Conductor

5 Liquid-Development Equipment

51 Developer Main Part

52 Developer Supply Unit

54 Development Belt

55 Developer Application Means

56 Developer Cleaning Means

61 Developer Storage Tank

62 Developer Stripping Section

63 Developer Feed Zone

64 High Concentration Developer Feed Zone

65 Low Concentration Developer Feed Zone

66 Viscometer

67 Churning Means

68 Criteria Viscosity Entry Section

69 Comparator

70 Drive Control Section

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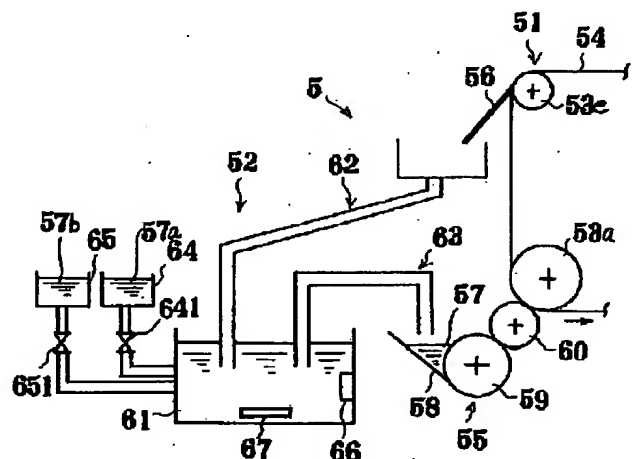
(74) 代理人 弁理士 小島 俊郎

(54) 【発明の名称】 液体现像装置

(57) 【要約】

【課題】 現像に使用する液体现像剤の濃度を適切な一定濃度に保って良質な画像を形成するとともに液体现像剤を有効に利用する。

【解決手段】 現像ベルト54から回収した液体现像剤が加えられる現像剤貯蔵タンク61内の液体现像剤の粘度Uを検出し、液体现像剤の粘度Uが許容粘度範囲を超えたときに高濃度の液体现像剤又は低濃度の液体现像剤を供給して現像剤貯蔵タンク61内の液体现像剤の粘度Uを初期粘度U₀にして、常に許容粘度範囲内の粘度を有する液体现像剤で感光体1に形成された静電潜像を可視化し、良質な画像を安定して形成する。



【特許請求の範囲】

【請求項1】 絶縁性液体からなる現像液溶媒中に顕像化粒子を高濃度に分散した高粘性の液体現像剤を現像剤担持体に薄層で塗布し、像担持体に形成された静電潜像を現像剤担持体に薄層で塗布された高濃度の液体現像剤に含まれる顕像化粒子で可視化する液体現像装置であって、

液体現像剤を現像剤担持体に塗布して液体現像剤薄層を形成する現像剤塗布手段に粘度をあらかじめ定めた一定範囲に調整した液体現像剤を供給する現像剤供給装置を有することを特徴とする液体現像装置。

【請求項2】 上記現像剤供給装置に現像領域通過後の現像剤担持体に残留している液体現像剤を回収する請求項1記載の液体現像装置。

【請求項3】 上記現像剤供給装置内の液体現像剤の粘度を検出し、液体現像剤の粘度があらかじめ定めた下限値以下になったときに顕像化粒子の比率が大きく粘度の高い液体現像剤を現像剤供給装置に供給し、液体現像剤の粘度があらかじめ定めた上限値以上になったときに顕像化粒子の比率が小さく粘度の低い液体現像剤を現像剤供給装置に供給する請求項1又は2記載の液体現像装置。

【請求項4】 上記現像剤供給装置内の液体現像剤の粘度を検出し、液体現像剤の粘度があらかじめ定めた下限値以下になったときに顕像化粒子を現像剤供給装置に供給し、液体現像剤の粘度があらかじめ定めた上限値以上になったときに絶縁性液体からなる現像液溶媒を現像剤供給装置に供給する請求項1又は2記載の液体現像装置。

【請求項5】 上記現像剤供給装置内の液体現像剤の初期粘度を U_o とし、絶縁性液体からなる現像液溶媒の粘度を U_c としたときに、現像剤供給装置内の液体現像剤の粘度 U を、

$$\{U_o - (U_o - U_c) / 2\} < U < \{U_o + (U_o - U_c) / 2\}$$

の範囲になるように調整する請求項3又は4記載の液体現像装置。

【請求項6】 上記現像剤供給装置内の液体現像剤を攪拌して均一な粘度にする請求項5記載の液体現像装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】この発明は電子写真方式等で形成された静電潜像を高粘度、高濃度の液体現像剤を用いて顕像化する液体現像装置、特に現像の均質化に関するものである。

【0002】

【従来の技術】高粘度、高濃度の液体現像剤を使って静電潜像を可視化する画像形成装置が、例えば特開平7-239614号公報や特開平8-123205号公報等に開示されている。この画像形成装置は、感光体表面を帯電手段で均

一に帯電してから、感光体表面にプリウエット液塗布手段で離型性を有し化学的に不活性な誘電性と光透過性を有するプリウエット液を均一な厚さで塗布する。その後、書込手段により画像データにしたがって感光体表面を露光して静電潜像を形成し液体現像装置で可視化する。

【0003】液体現像装置は、例えばジメチルポリシロキサンオイル等の絶縁性液体からなる現像液溶媒中に顕像化粒子であるトナーが高濃度に分散された高粘性の液体現像剤で静電潜像を可視化するものであり、現像剤塗布手段で液体現像剤を均一な厚さで現像ベルトや現像ローラに塗布し、現像ベルトや現像ローラに塗布された液体現像剤薄層が感光体に近接して現像領域を通るとき、液体現像剤薄層のトナーが感光体の画像領域に転移してトナー像を形成する。感光体に形成されたトナー像を転写手段で転写紙に転写し、転写紙に転写したトナー像を定着して画像を形成する。転写工程終了後の感光体に残留したトナーとプリウエット液はクリーニング手段で除去し、感光体に残っている電荷を除電手段によって除去して画像形成工程を終了する。また、現像領域を通った現像ベルトや現像ローラには感光体に塗布したプリウエット液が付着して現像に使用されずに残った液体現像剤と混合する。この現像領域を通った現像ベルトや現像ローラに付着している液体現像剤とプリウエット液を現像剤塗布手段に回収して再利用したり、廃液回収タンクに回収して廃棄したり、回収した液体現像剤とプリウエット液を分離し、分離した液体現像剤を再利用している。

【0004】上記のように現像領域を通った現像ベルトや現像ローラに付着している液体現像剤とプリウエット液を回収して廃棄すると液体現像剤が無駄になり稼動コストが高くなってしまふ。また、液体現像剤とプリウエット液を分離して再利用する場合、現像装置に分離機構を備えることが実用上困難な場合があるとともにプリウエット液の性質によっては液体現像剤と分離できない場合もある。そこで通常は現像剤塗布手段に回収して再利用している。

【0005】

【発明が解決しようとする課題】液体現像剤を使用して静電潜像を可視化する場合、液体現像剤のトナーは画像の有無あるいはその比率に応じて消費されるが、溶媒の付着量は画像の有無にはさほど依存しない。通常、一定の比率で溶媒中にトナーが分散した液体現像剤を用いているが、例えば画像面積の比率が高い静電潜像を繰り返して現像した場合、溶媒の消費に比べてトナーの消費が著しく大きくなり、溶媒に対してトナーの比率が低い液体現像剤が現像剤塗布手段に回収され、現像剤塗布手段内の液体現像剤の溶媒とトナーとの比率である濃度が低下する。液体現像剤の濃度が低下すると形成された画像の濃度も低下してしまふ。

【0006】逆に画像面積比率の低い静電潜像の現像を

繰り返した場合、溶媒に対してトナーの比率の高い液体現像剤が現像剤塗布手段に回収され、現像剤塗布手段内の液体現像剤の溶媒とトナーとの比率である濃度が高くなってしまふ。現像剤塗布手段内の液体現像剤の濃度が高くなると液体現像剤の粘度が高くなり、現像ベルトや現像ローラに液体現像剤を塗布するときの付着量に変化して均一な厚さの液体現像剤薄層を形成しにくくなるとともに現像した画像濃度にムラ等が生じて画質が劣化してしまふ。

【0007】この発明はかかる短所を改善するためになされたものであり、現像に使用する液体現像剤の濃度を適切な一定濃度に保って良質な画像を形成するとともに液体現像剤を有効に利用することができる液体現像装置を得ることを目的とするものである。

【0008】

【課題を解決するための手段】この発明に係る液体現像装置は、絶縁性液体からなる現像液溶媒中に顕像化粒子を高濃度に分散した高粘性の液体現像剤を現像剤担持体に薄層で塗布し、像担持体に形成された静電潜像を現像剤担持体に薄層で塗布された高濃度の液体現像剤に含まれる顕像化粒子で可視化する液体現像装置であつて、液体現像剤を現像剤担持体に塗布して液体現像剤薄層を形成する現像剤塗布手段に粘度をあらかじめ定めた一定範囲に調整した液体現像剤を供給する現像剤供給装置を有することを特徴とする。

【0009】上記現像剤供給装置に現像領域通過後の現像剤担持体に残留している液体現像剤を回収すると良い。

【0010】また、上記現像剤供給装置内の液体現像剤の粘度を検出し、液体現像剤の粘度があらかじめ定めた下限値以下になったときに顕像化粒子の比率が大きく粘度の高い液体現像剤を現像剤供給装置に供給し、液体現像剤の粘度があらかじめ定めた上限値以上になったときに顕像化粒子の比率が小さく粘度の低い液体現像剤を現像剤供給装置に供給する。

【0011】上記現像剤供給装置内の液体現像剤の粘度があらかじめ定めた下限値以下になったときに顕像化粒子を現像剤供給装置に供給し、液体現像剤の粘度があらかじめ定めた上限値以上になったときに絶縁性液体からなる現像液溶媒を現像剤供給装置に供給しても良い。

【0012】また、現像剤供給装置内の液体現像剤の初期粘度を U_0 とし、絶縁性液体からなる現像液溶媒の粘度を U_c としたときに、現像剤供給装置内の液体現像剤の粘度 U を、 $\{U_0 - (U_0 - U_c) / 2\} < U < \{U_0 + (U_0 - U_c) / 2\}$ の範囲になるように調整することが望ましい。

【0013】さらに、現像剤供給装置内の液体現像剤を攪拌して均一な粘度にすると良い。

【0014】

【発明の実施の形態】この発明の液体現像装置は現像装

置本体と現像剤供給ユニットを有する。現像装置本体は感光体の表面移動速度と同じ表面移動速度で移動する現像ベルトと現像剤塗布手段及び現像剤クリーニング手段とを有する。現像剤供給ユニットは現像剤貯蔵タンクと現像剤回収部と現像剤供給部と高濃度現像剤供給部及び低濃度現像剤供給部を有する。現像剤貯蔵タンクには粘度計と攪拌手段を有し、現像剤塗布手段に供給する液体現像剤を貯蔵する。現像剤供給部は現像剤貯蔵タンクに貯蔵している液体現像剤を現像剤塗布手段に供給する。高濃度現像剤供給部はトナーの比率が大きく粘度が高い高濃度液体現像剤を貯蔵し、貯蔵している高濃度液体現像剤を現像剤貯蔵タンクに供給する。低濃度現像剤供給部はトナーの比率が少なく粘度が低い低濃度液体現像剤を貯蔵し、貯蔵している低濃度液体現像剤を現像剤貯蔵タンクに供給する。

【0015】この液体現像装置で感光体に形成された静電潜像を現像して可視化するときは、回転している現像ベルトに現像剤塗布手段で液体現像剤の均一な厚さの液体現像剤薄層を形成する。この現像ベルトに形成された均一な厚さの液体現像剤薄層に含まれるトナーで感光体の静電潜像を可視化する。この現像工程後に現像ベルトに残った液体現像剤は現像剤クリーニング手段により除去され、除去された液体現像剤は現像剤供給ユニットの現像剤回収部により現像剤貯蔵タンクに回収される。

【0016】この現像剤貯蔵タンクに回収される液体現像剤のなかの現像剤溶媒は現像工程で常に一定量消費されるのに対してトナーが現像する画像の面積に応じて変動し、現像剤貯蔵タンクに回収される液体現像剤の現像剤溶媒に対するトナーの比率すなわち濃度に変化している可能性がある。そこで現像剤貯蔵タンク内の粘度計で感光体ベルトから回収した液体現像剤が加えられる現像剤貯蔵タンク内の液体現像剤の粘度を検出し、現像剤貯蔵タンク内の液体現像剤の粘度が許容粘度範囲の下限値より低くなったら、高濃度現像剤供給部から現像剤貯蔵タンクに高濃度の液体現像剤を供給し、攪拌手段で現像剤貯蔵タンク内の液体現像剤を攪拌して供給された高濃度の液体現像剤と混合して均一な粘度にし現像剤貯蔵タンク内の液体現像剤の粘度を初期粘度に調整する。また、現像剤貯蔵タンク内の液体現像剤の粘度が許容粘度範囲の上限値より高くなったら低濃度現像剤供給部から現像剤貯蔵タンクに低濃度の液体現像剤を供給して現像剤貯蔵タンク内の液体現像剤の粘度を初期粘度に調整する。

【0017】このように、現像ベルトから回収した液体現像剤が加えられる現像剤貯蔵タンク内の液体現像剤の粘度 U を検出し、液体現像剤の粘度 U が許容粘度範囲を超えたときに高濃度の液体現像剤又は低濃度の液体現像剤を供給して現像剤貯蔵タンク内の液体現像剤の粘度 U を初期粘度 U_0 にするから、常に許容粘度範囲内の粘度を有する液体現像剤で感光体に形成された静電潜像を可

視化することができ、良質な画像を安定して形成することができる。

【0018】また、液体現像剤の粘度 U が許容粘度範囲を超えたときに高濃度の液体現像剤又は低濃度の液体現像剤を供給するとともに攪拌手段で攪拌して現像剤貯蔵タンク内の液体現像剤の粘度を均一な粘度にするから、形成された画像に濃度ムラ等が生じることを防ぐことができる。

【0019】さらに、初期粘度 U_o に対する許容粘度範囲($U_o \pm \Delta U_o$)を定める限界値 ΔU_o は、現像液溶媒の粘度を U_c として、 $\Delta U_o = (U_o - U_c) / 2$ と設定すると、常に良質な画像を形成することができる。

【0020】また、高濃度の液体現像剤又は低濃度の液体現像剤の代わりにトナー又は現像液溶媒を供給しても良い。

【0021】

【実施例】図1はこの発明の一実施例の液体現像装置を使用した湿式画像形成装置の構成図である。湿式画像形成装置は、図に示すように、時計方向に回転する感光体1に沿って配置された帯電手段2とプリウエット液塗布手段3と書込手段4と液体現像装置5と転写手段6と除電手段7及びクリーニング手段8を有する。感光体1は帯電手段2で表面が均一に帯電されたのちプリウエット液塗布手段3で離型性を有し化学的に不活性な誘電性と光透過性を有するプリウエット液を均一な厚さで塗布される。この表面が均一に帯電しプリウエット液が塗布された感光体1を書込手段4により画像データにしたがって露光して静電潜像を形成する。この感光体1に形成された静電潜像を液体現像装置5で可視化してトナー像を形成し、形成したトナー像を転写手段6で転写紙9に転写する。トナー像を転写紙9に転写した感光体1に残っている電荷を除電手段7で除電し、残留したトナーとプリウエット液はクリーニング手段7で除去して次の画像形成工程に入る。

【0022】液体現像装置5は、例えばジメチルポリシロキサンオイル等の絶縁性液体からなる現像液溶媒中に顕像化粒子であるトナーが高濃度に分散された高粘性の液体現像剤で静電潜像を可視化するものであり、現像装置本体51と現像剤供給ユニット52を有する。現像装置本体51は複数の回転ローラ53a～53eに巻回され感光体1の表面移動速度と同じ表面移動速度で反時計方向に移動する現像ベルト54と現像剤塗布手段55及び現像剤クリーニング手段56とを有する。現像ベルト54はバイアス印加手段(不図示)により、感光体1上の潜像電位の最小値と最大値の間の電位が印加されている。現像剤塗布手段55は現像液溶媒中にトナーを分散した高粘度の液体現像剤57が貯えられた現像剤貯蔵部58と供給ローラ59と塗布ローラ60を有し、現像ベルト54表面に均一な厚さの液体現像剤薄層を形成する。現像剤クリーニング手段56は現像領域を通過した

現像ベルト54に残留している液体現像液を回収する。

【0023】現像剤供給ユニット52は、図2に示すように、現像剤貯蔵タンク61と現像剤回収部62と現像剤供給部63と高濃度現像剤供給部64及び低濃度現像剤供給部65を有する。現像剤貯蔵タンク61には粘度計66と攪拌手段67を有し、現像剤塗布手段55に供給する液体現像剤を貯蔵する。現像剤回収部62は現像剤クリーニング手段56で回収した液体現像液を現像剤貯蔵タンク61に送る。現像剤供給部63は現像剤貯蔵タンク61に貯蔵している液体現像剤を現像剤塗布手段55に供給する。高濃度現像剤供給部64は最適画像濃度の画像を形成するため現像液溶媒に対するトナーの比率を最適に調整して粘度が U_o の液体現像剤よりトナーの比率が大きく粘度が高い高濃度液体現像剤57aを貯蔵し、貯蔵している高濃度液体現像剤57aを現像剤貯蔵タンク61に供給する。低濃度現像剤供給部65は粘度が U_o の液体現像剤よりトナーの比率が少なく粘度が低い低濃度液体現像剤57bを貯蔵し、貯蔵している低濃度液体現像剤57bを現像剤貯蔵タンク61に供給する。

【0024】現像剤供給ユニット52の制御部には、図3に示すように、基準粘度範囲設定部68と比較部69及び駆動制御部70とを有する。基準粘度範囲設定部68は現像剤貯蔵タンク61に貯蔵している液体現像剤を適正な粘度すなわち適正なトナー含有率に制御するための基準粘度範囲を設定する。比較部69は粘度計66で検出した現像剤貯蔵タンク61に貯蔵している液体現像剤の粘度と基準粘度範囲設定部68で設定された基準粘度範囲とを比較し、現像剤貯蔵タンク61に貯蔵している液体現像剤の粘度が基準粘度範囲内か否を判定する。駆動制御部70は比較部69の判定結果により高濃度現像剤供給部64の供給手段641と低濃度現像剤供給部65の供給手段651のいずれかと攪拌手段67を駆動する。

【0025】上記のように構成した液体現像装置5において、現像剤供給ユニット52の現像剤貯蔵タンク61には初期時には最適画像濃度の画像を形成するために現像液溶媒に対するトナーの比率を最適に調整した初期粘度 U_o の液体現像剤が貯蔵してあり、この液体現像剤が現像剤塗布手段55の現像剤貯蔵部58に供給されている。この液体現像装置5で感光体1に形成された静電潜像を現像して可視化するときは、反時計方向に回転している現像ベルト54に現像剤塗布手段55で液体現像剤57の均一な厚さの液体現像剤薄層を形成する。この現像ベルト54に形成された均一な厚さの液体現像剤薄層に含まれるトナーで感光体1の静電潜像を可視化する。この感光体1の静電潜像を可視化するときに、静電潜像の画像部だけにトナーが付着し、キャリアである現像液溶媒は感光体1の全領域に付着する。この現像工程後に現像ベルト54に残った液体現像剤は現像剤クリーニン

グ手段56により除去され、除去された液体现像剤は現像剤供給ユニット52の現像剤回収部62により現像剤貯蔵タンク61に回収される。

【0026】この現像剤貯蔵タンク61に回収される液体现像剤のなかの現像剤溶媒は現像工程で常に一定量消費されるのに対してトナーが現像する画像の面積に応じて変動し、現像剤貯蔵タンク61に回収される液体现像剤の現像剤溶媒に対するトナーの比率すなわち濃度が変化している可能性があり、この回収した液体现像剤が現像剤貯蔵タンク61内の液体现像剤に加えられると、現像剤貯蔵タンク61内の液体现像剤の濃度すなわち粘度が初期粘度 U_0 から変化してしまう。液体现像剤の粘度、すなわち現像剤溶媒に対するトナーの比率は、図4の粘度と画像濃度の特性図に示すように、感光体1の静電潜像を可視化したときの画像濃度に直接影響し、現像剤貯蔵タンク61内の液体现像剤、すなわち現像剤塗布手段55に供給する液体现像剤の粘度が低下すると、感光体1に形成された画像の濃度も低下し、液体现像剤の粘度が一定限度低下すると画像の品質が劣化してしまう。また、現像剤貯蔵タンク61内の液体现像剤の粘度が高くなると、現像剤塗布手段55で現像ベルト54に液体现像剤を塗布するときの付着量に変化して均一な厚さの液体现像剤薄層を形成しにくくなり、画像濃度にムラ等が生じてしまう。

【0027】そこで現像剤貯蔵タンク61内の粘度計66で現像ベルト54から回収した液体现像剤が加えられる現像剤貯蔵タンク61内の液体现像剤の粘度 U を常時又は一定の時間タイミングで検出して比較部69に送る。比較部69は送られた液体现像剤の粘度 U とあらかじめ基準粘度範囲設定部68に設定されている初期粘度 U_0 に対する許容粘度範囲($U_0 \pm \Delta U_0$)と比較し、現像剤貯蔵タンク61内の液体现像剤の粘度 U が許容粘度範囲($U_0 \pm \Delta U_0$)を超えているかどうかを判断する。比較部69は、この比較の結果、現像剤貯蔵タンク61内の液体现像剤の粘度 U が許容粘度範囲($U_0 \pm \Delta U_0$)を超えているときは、液体现像剤の粘度 U が許容粘度範囲の下限值($U_0 - \Delta U_0$)より低いか、上限値を($U_0 + \Delta U_0$)より高いかを示す信号を駆動制御部70に送る。駆動制御部70は液体现像剤の粘度 U が許容粘度範囲の下限值($U_0 - \Delta U_0$)より低いことを示す信号を受けると高濃度現像剤供給部64の供給手段641を駆動して現像剤貯蔵タンク61に高濃度の液体现像剤57aを供給し、同時に攪拌手段67を駆動して現像剤貯蔵タンク61内の液体现像剤を攪拌して供給された高濃度の液体现像剤57aと混合して均一な粘度にする。この高濃度の液体现像剤57aを供給しているときに粘度計66は検出して現像剤貯蔵タンク61内の液体现像剤の粘度 U を比較部69に送る。比較部69は現像剤貯蔵タンク61内の液体现像剤の粘度 U が初期粘度 U_0 になると駆動制御部70に供給停止信号を送り、高濃

度現像剤供給部64の供給手段641の駆動を停止させる。また、駆動制御部70は液体现像剤の粘度 U が許容粘度範囲の上限値($U_0 + \Delta U_0$)より高いことを示す信号を受けると低濃度現像剤供給部65の供給手段651を駆動して現像剤貯蔵タンク61に低濃度の液体现像剤57bを供給し、攪拌手段67を駆動して現像剤貯蔵タンク61内の液体现像剤を攪拌して供給された低濃度の液体现像剤57bと混合して均一な粘度にし、現像剤貯蔵タンク61内の液体现像剤の粘度 U を初期粘度 U_0 に調整する。

【0028】このように、感光体ベルト54から回収した液体现像剤が加えられる現像剤貯蔵タンク61内の液体现像剤の粘度 U を検出し、液体现像剤の粘度 U が許容粘度範囲($U_0 \pm \Delta U_0$)を超えたときに高濃度の液体现像剤57a又は低濃度の液体现像剤57bを供給して現像剤貯蔵タンク61内の液体现像剤の粘度 U を許容粘度範囲($U_0 \pm \Delta U_0$)にするから、常に許容粘度範囲($U_0 \pm \Delta U_0$)内の粘度を有する液体现像剤で感光体1に形成された静電潜像を可視化することができ、良質な画像を安定して形成することができる。また、液体现像剤の粘度 U が許容粘度範囲($U_0 \pm \Delta U_0$)を超えたときに高濃度の液体现像剤57a又は低濃度の液体现像剤57bを供給するとともに攪拌手段67で攪拌して均一な粘度にするから、形成された画像に濃度ムラ等が生じることを防ぐことができる。

【0029】また、基準粘度範囲設定部68に設定する初期粘度 U_0 に対する許容粘度範囲($U_0 \pm \Delta U_0$)を定める限界値 ΔU_0 は、現像液溶媒の粘度を U_c として、図5のトナー固形分率と粘度の特性図に示すように、 $\Delta U_0 = (U_0 - U_c) / 2$ と設定すると、常に良質な画像を形成することができた。

【0030】また、上記実施例は感光体ベルト54から回収した液体现像剤が加えられる現像剤貯蔵タンク61内の液体现像剤の粘度 U が許容粘度範囲($U_0 \pm \Delta U_0$)を超えたときに高濃度の液体现像剤57a又は低濃度の液体现像剤57bを供給した場合について説明したが、液体现像剤の粘度 U が許容粘度範囲の下限值($U_0 - \Delta U_0$)より低いときに現像剤貯蔵タンク61内の液体现像剤にトナーを供給し、液体现像剤の粘度 U が許容粘度範囲の上限値($U_0 + \Delta U_0$)より高いときに現像剤貯蔵タンク61内の液体现像剤に粘度 U_c の現像液溶媒を供給するようにしても良い。

【0031】

【発明の効果】この発明は以上説明したように、現像ベルトから回収した液体现像剤が加えられる現像剤貯蔵タンク内の液体现像剤の粘度を検出し、液体现像剤の粘度が許容粘度範囲を超えたときに高濃度の液体现像剤又は低濃度の液体现像剤を供給して現像剤貯蔵タンク内の液体现像剤の粘度を初期粘度にするから、常に許容粘度範囲内の粘度を有する液体现像剤で感光体に形成された静

電潜像を可視化することができ、良質な画像を安定して形成することができる。

【0032】また、液体现像剤の粘度が許容粘度範囲を超えたときに高濃度の液体现像剤又は低濃度の液体现像剤を供給するとともに攪拌手段で攪拌して現像剤貯蔵タンク内の液体现像剤の粘度を均一な粘度にするから、形成された画像に濃度ムラ等が生じることを防ぐことができる。

【0033】さらに、初期粘度 U_0 に対する許容粘度範囲($U_0 \pm \Delta U_0$)を定める限界値 ΔU_0 は、現像液溶媒の粘度を U_c として、 $\Delta U_0 = (U_0 - U_c) / 2$ と設定することにより、常に良質な画像を形成することができる。

【0034】また、高濃度の液体现像剤又は低濃度の液体现像剤の代わりにトナー又は現像液溶媒を供給することにより、現像に使用する液体现像剤の粘度を簡単に調整することができる。

【図面の簡単な説明】

【図1】この発明の実施例の構成図である。

【図2】液体现像装置の構成図である。

【図3】現像剤供給ユニットの制御部の構成を示すブロック図である。

ック図である。

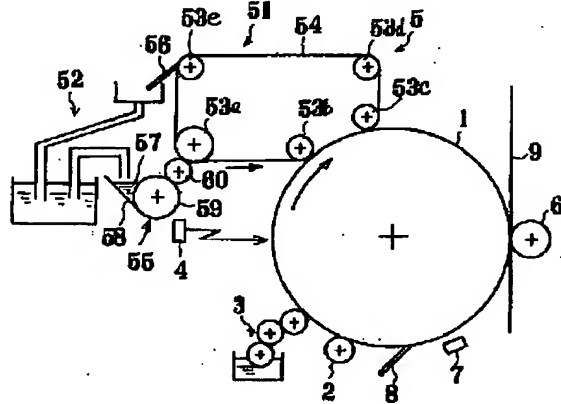
【図4】粘度と画像濃度の特性図である。

【図5】トナー固形分率と粘度の特性図である。

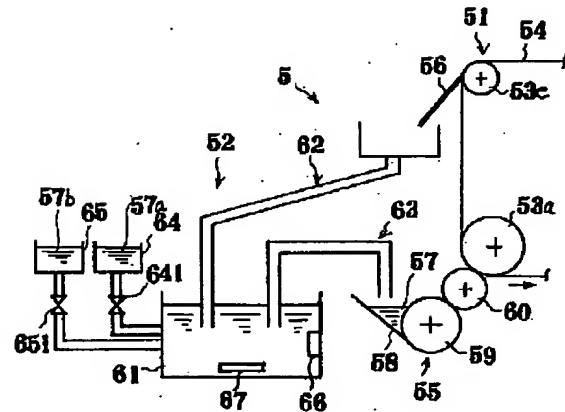
【符号の説明】

- 1 感光体
- 5 液体现像装置
- 51 現像装置本体
- 52 現像剤供給ユニット
- 54 現像ベルト
- 55 現像剤塗布手段
- 56 現像剤クリーニング手段
- 61 現像剤貯蔵タンク
- 62 現像剤回収部
- 63 現像剤供給部
- 64 高濃度現像剤供給部
- 65 低濃度現像剤供給部
- 66 粘度計
- 67 攪拌手段
- 68 基準粘度範囲設定部
- 69 比較部
- 70 駆動制御部

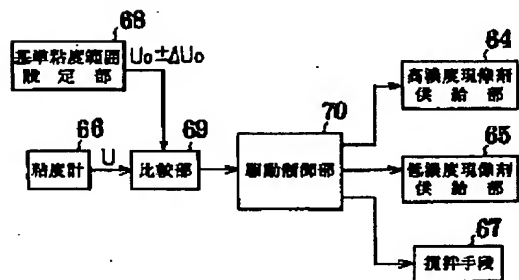
【図1】



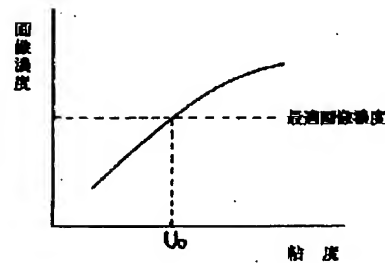
【図2】



【図3】



【図4】



【図5】

